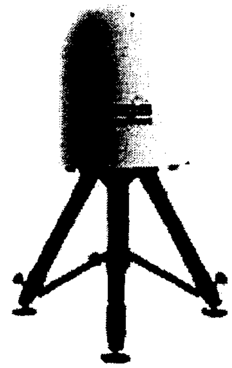
Hemi Track



- Mobile microwave system for video, voice, or data
- Compact, lightweight
- Integrated microwave receiver
- Navtrack Automatic Antenna Steering
- Simple, modular control system
- Optional transmit capability
- Available in Van Mounted applications

The new HemiTrack™ series of products from Wescam begins a new era in real-time image acquisition and transmission. The system may be used either to manually receive from a stationary transmitter, or to continuously Navtrack a mobile source such as a helicopter, airplane, or a ground vehicle. HemiTrack™ delivers broadcast-quality video and audio. The HemiTrack control system is designed to be intuitive, and requires no special operator training or hands-on effort. HemiTrack™ systems, typically used as receive only, may also be configured as transmit only, or transmit and receive in frequency ranges from 1.7 to 7 Ghz. Best of all, these systems are based on commercial satellite and avionics technologies. With Wescam's field proven Navtrack system and processing expertise, you get the most reliable and economical solution available.

HemiTrack™ is an ideal choice for deployable video needs in Electronic Newsgathering (ENG), Sports Broadcasting, Airborne Law Enforcement (ALE), surveillance, maritime patrol, tactical security, or anywhere professionals need real-time decision support information.

Profile

Command & Control

Electronic News Gathering

Airborne Law Enforcement

All terrain Vehicle

Van

Tripod

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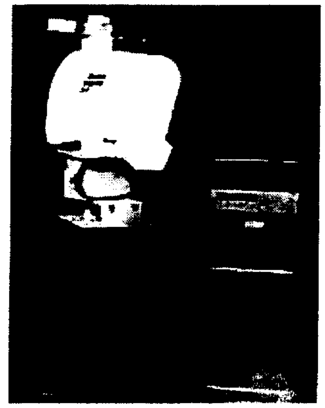
Skypod V Skypod LC OMN-ADU PRO-300 ULT-160 HemiTrack TrollTrack

Trolltrack



- **Eliminate tedious or near-impossible alignment and automate the link between mobile vehicles and airborne systems**
- **TrollTrack may be supplied with a variety of video management options, and with portable tripod or vehicular mounts**

When a story is hot and time is critical, you don't have the time for tedious or near-impossible alignment of antennas to link your roving news vans or SNG trucks with airborne systems. Wescam's exclusive TrollTrack system provides you with a fast, automatic way to acquire and track your airborne signal from a portable site, ensuring maximum signal strength for best possible picture integrity. This self-calibrating system provides the ease of use and the reliability necessary for real-time coverage when you really need it.

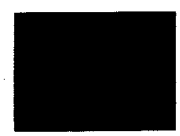
TrollTrack incorporates a complete microwave receiver and antenna system, an integrated GPS navigational system, a three-axis solid-state magnetometer, Wescam's hardy TS-1480 master and TS-940SL slave controller, as well as optional video management systems, TrollTrack uses NavTrack telemetry data from the airborne source to automatically acquire and then hold onto the signal. The tripod mounted antenna can be set up in almost any orientation and will automatically self-calibrate when commanded to do so. TrollTrack systems are available in versions to cover the 1.7 GHz to 7 GHz bands, and special versions covering up to 15 GHz are currently in development.

Profile

Typical Applications (click to view)

Command & Control

Typical Installations (click to view)



AB-VIDEO™ SERIES ◇ 2, 7, and 13 GHz central receive antenna

MRC™ ProScan™ & ProScan II

MAIN FEATURES

- 1.4 meter CSC² eliminates requirements for elevation travel in most applications
- High strength, lightweight honeycomb construction
- Broadband design covers 2/2.5, 6.4/7, and 13 GHz
- Right circular, left circular, horizontal and vertical polarization

ROTATOR

- Ruggedized rotating mechanism
- Dual speed
- Built-in surge suppression
- All external metal parts are aluminum with stainless steel hardware
- Continuous rotation option

LNA/BLOCK DOWNCONVERTER

- 26 dB gain LNA (2 GHz)
- 6.4/7 GHz block downconverter (used with dual-band system)
- 6.4/7 and 13 GHz block downconverter (for triband system)

PROSCAN II OPTION

- Newly designed solid-state switching feed
- New high dynamic range LNA and bandpass filter to combat PCS interference.

The MRC ProScan is a highly ruggedized offset fed antenna incorporating a downward looking cosecant squared reflector, thus eliminating the requirement for elevation travel in most applications. The offset feed design allows greater feed efficiencies and reduced sidelobes.

The feed is broadband covering the 2/2.5 GHz range. A dual-band antenna system is available covering both the 2/2.5 GHz and 6.4/7 GHz bands and a triband system is also available covering 12.7 to 13.2 GHz, in addition to 2 GHz and 7 GHz. The feed design permits a full range of remote switching options with the LNA/block downconverter internal to the feed to minimize signal loss through cables.

The dual-speed rotator is enclosed in a ruggedized welded housing with hinged doors on 2 sides for ease of access. It has been designed using proven technology for reliability. It comes equipped with a coaxial rotary joint to minimize RF cable failures. Lightning and surge suppression is provided within the MRC ProScan. The rotator and enclosure are constructed of aluminum and stainless steel; no steel is used on external parts thus eliminating the possibility of corrosion. Continuous rotation is available as a system option.

The MRC ProScan II central receive antenna features a newly designed solid-state switched feed. The feed offers improved reliability through the elimination of all electro-mechanical coaxial switches. The switching is performed through the latest in solid-state microwave technology. This design also reduces the DC operating power of the feed. The MRC ProScan II also features a new bandpass filter and high dynamic range LNA design. This design was initiated to combat the interference issues which have become common-place with the introduction of PCS systems. The combination of a high dynamic range LNA and sharper filtering make the MRC ProScan II a "bullet-proof" solution to the PCS problem.

ADAPTIVE BROADBAND

MRC ProScan CENTRAL RECEIVE ANTENNA SPECIFICATIONS

RF

Model:	2 GHz	7 GHz	13 GHz
Frequency Range (GHz):	2.0 – 2.5	6.4 – 7.1	12.7 - 13.2
Gain*:	26 dBi	36 dBi	41 dBi
1st Sidelobe Attenuation:	28 dBi max	19.5 dBi max	19.5dBi max

* Gain is for basic antenna net of switching options.

BEAMWIDTH

	2 GHz	7 GHz	13 GHz
Azimuth P+HPBW:	7.6°	2.4°	1.5°
Elevation HPBW:	7.2° to CSC²	3.8° to CSC²	1.8° to CSC²

REFLECTOR

Type:	Cosecant squared (CSC²) reflector:
Construction:	High-strength, lightweight honeycomb
Polarization:	LCP, RCP, horizontal, and vertical

FEED

Configurations:	2 GHz broadband or 2/7 GHz dual-band
Broadband:	2/2.5, 6.4/7, and 13 GHz
LNA:	Built in 26 dB gain LNA
Dual Band:	Optional 6.4/7 GHz block downconverter
Triband:	Optional 6 and 13 GHz block downconverter

ROTATOR

Dual Speed:	Slow: 3°/second Fast: 15°/second
Backlash:	+0.2°
Maximum Wind Load:	125 mph operating
Rotation:	360°, -5°overlap

ENVIRONMENTAL

Temperature Range:	-30°C to +60°C

PHYSICAL

Reflector Size:	54" (1.4 meter) dia.
System Weight:	250 lbs (114 kg) max

ORDERING INFORMATION

ProScan ANTENNA SYSTEMS

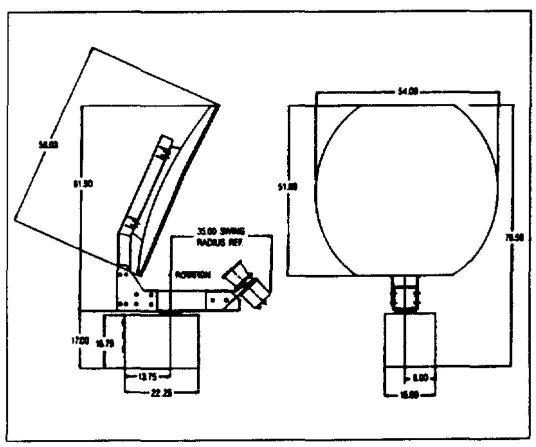
901140-1	2 GHz ProScan without local control
901140-2	2/7 GHz ProScan without local control

ProScan II ANTENNA SYSTEMS

PROII-2	2 GHz ProScan II with solid-state feed
PROII-7	7 GHz ProScan II with solid-state feed
PROII-27	2/7 GHz simultaneous ProScan II with solid-state Feed
PROII-2713	2/7/13 GHz simultaneous ProScan II with solid-state Feed

ProScan OPTIONS

CRO-PRO	Continuous Rotation Option
901594-1	Radome, unheated
842746-2	ProScan control cable and connectors (specify length in feet)
902864	LNA Bypass Option
52700-50	Band Filter (1.99 to 2.110 GHz)
902815-1	2 – 2.5 GHz Band Filter
901586-1	High Gain Linear Amp, 30 dB, DC without bypass
901586-2	High Gain Linear Amp, 30 dB, DC with bypass



MRC ProScan ANTENNA

Product dimensions in inches

ADAPTIVE BROADBAND

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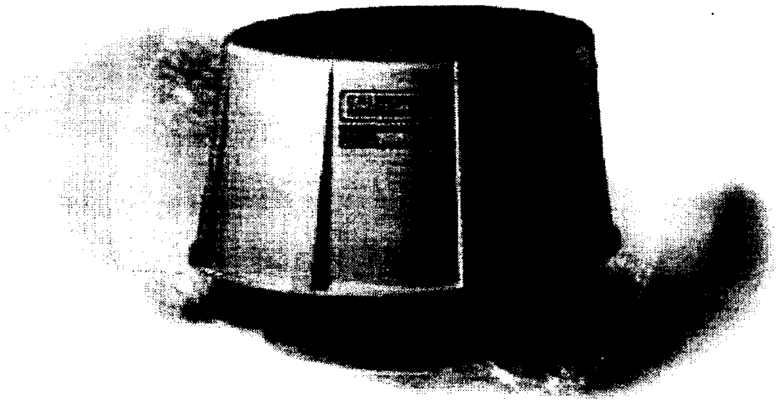
Adaptive Broadband products are manufactured under a quality system certified to ISO 9001. Adaptive Broadband reserves the right to make changes to specifications of products described in this data sheet at any time without notice and without obligation to notify any person of such changes.

AB-VIDEO™ SERIES ◇ 2, 7, and 13 GHz central receive antenna

MRC™ ULTRASCAN™ & ULTRASCAN II



MAIN FEATURES

- All solid state switching: no RF electro-mechanical switches
- Low noise amplifier and filter integrated into feed
- Low profile
- Lightweight
- Broadband design:
  - Wideband, 2/2.5 GHz
  - Optional dualband, 2/7 GHz
  - Optional triband 2/7/13 GHz
- Right circular, left circular, horizontal, and vertical polarization

ROTATOR

- Ruggedized rotating mechanism
- Dual speed
- Easily removed top radome for ease of access
- Build-in surge suppression
- All external metal parts are aluminum with stainless steel hardware

LNA/BLOCK DOWNCONVERTER

- 26 dB gain LNA
- 6.4/7 and 13 GHz block downconverter (used with dual-band and triband systems)

ULTRASCAN II OPTION

- New, improved low noise amplifier and filter integrated into feed for PCS interference protection
- New LNB design offers low noise figure, high dynamic range and third order intercept point
- New, improved lower noise block downconverter (used with 7 & 13 GHz systems)

The MRC UltraScan is a highly ruggedized offset fed antenna enclosed in a low profile radome that minimizes space needs and wind loading. The feed is broadband covering the 2/2.5 GHz band; a dual-band model covers both the 2/2.5 GHz and 6.4/7 GHz bands. A triband model covers these as well as the 13 GHz band.

The MRC UltraScan antenna uses modern solid-state MMICs to perform RF switching in the feed, thus eliminating all electro-mechanical RF switches.

To provide optimal per formance, the MRC UltraScan feed assembly includes low noise amplifiers, solid state RF switches, RF band filter, and microstrip combiners and hybrids in an integrated RF assembly. LNA gain reduction is provided as a standard feature to reduce receiver overloading under strong signal conditions.

In addition, the overall power requirements of the rotating system and feed assembly are lower than those of traditional systems, thereby reducing the size and weight of the interconnecting control cable.

The feed design permits a full range of remote switching options with the LNA/block down conver ter mounted in close proximity to the feed to minimize the loss occurred through cables.

The dual-speed rotator is enclosed in a low-profile, aesthetically pleasing radome. It has been designed using proven technology for reliability . Lightning and surge suppression is provided within the unit. The rotator and enclosure are constructed of aluminum and stainless steel, thus eliminating the possibility of corrosion .

The new MRC UltraScan II central receive antenna option features a newly designed front-end, which consists of a solid-state pin diode switching unit. A new sharper response RF bandpass filter, and new high dynamic range LNA design are also employed. This design was initiated to combat the interference issues which have become commonplace with the introduction of PCS systems adjacent to ENG central receive sites. The combination of a high dynamic range LNA and sharper filtering mak e the MRC UltraScan II a "bullet-proof" solution to the problem of PCS interference.

The MRC UltraScan can be ordered with a continuous rotation option, which includes slip rings and an RF rotary joint. Adaptive Broadband also offers a range of modern , easy to use antenna control systems for the MRC UltraScan antenna and the MRC Millennium CR Central R eceiver.

ADAPTIVE BROADBAND™

MRC UltraScan CENTRAL RECEIVE SPECIFICATIONS

GENERAL

Antenna Type:	Offset Fed Parabola		
Model:	2 GHz	6.5/7 GHz	13 GHz
Frequency Range (GHz)*:	1.99 – 2.5	6.45 – 7.125	12.7 – 13.2
Gain, nominal†:	20 dBi	30 dBi	35 dBi
Beamwidth, Horizontal**:	14°	4.2°	2.5°
Beamwidth, Vertical**:	22°	7.2°	7.5°
Front to Back Rejection:	-25 dB minimum		
Side Lobe Rejection:	-20 dB minimum		

* 1.7 to 1.85 and 2.3 to 2.7 GHz also available.

† Gain is for basic antenna net of switching options.

** HPBW specifications are mid-band.

REFLECTOR

Type:	18" x 30" offset
Construction:	High strength, lightweight
Polarization:	Quad polarization standard (left circular, right circular, horizontal, and vertical)

FEED

Configurations:	2 GHz Broadband, 2/7 GHz Dual Band, or 2/7/13 GHz Triband
LNA:	Built in 26 dB gain LNA
Dual Band:	6.4/7 GHz block downconverter
Triband:	6/13 GHz block downconverter

ROTATOR

Dual Speed:	Slow: 3°/second Fast: 15°/second
Operating Wind Load:	Exceeding 100 mph
Rotation:	360°, -5°overlap

ENVIRONMENTAL

Temperature Range:	-30°C to +60°C

PHYSICAL

Reflector Size:	18" h x 30" w (46 x 76 cm)
Antenna Size with Radome:	28" h x 35" dia (71 x 89 cm)
System Weight:	65 lbs (29.5 kg)

ORDERING INFORMATION

UltraScan ANTENNA SYSTEMS

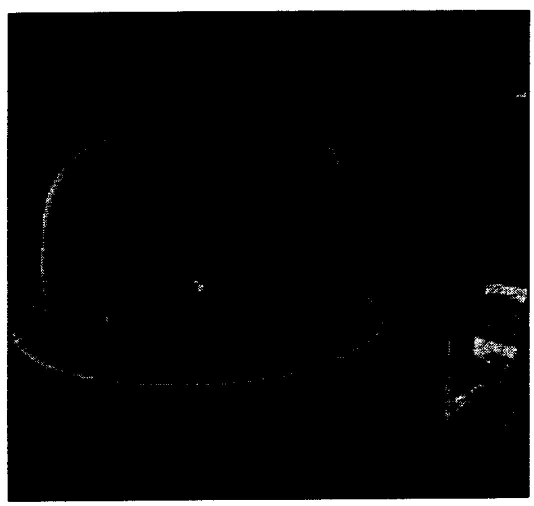
903655-1	2/2.5 GHz UltraScan Quad Polarization
903655-2	2/7 GHz UltraScan Dual-Band Quad Polarization
903655-3	2/2.5 GHz, Quad Polarization, Continuous Rotation
903655-4	2/7 GHz Dual-Band Quad Polarization, Continuous Rotation

UltraScan II ANTENNA SYSTEMS

USCANII-2	2/2.5 GHz UltraScan II Quad Polarization
USCANII-27	2/7 GHz UltraScan II Dual-Band Quad Polarization
USCANII-2C	2/2.5 GHz, Quad Polarization, Continuous Rotation, UltraScan II
USCANII-27C	2/7 GHz Dual-Band Quad Polarization, Continuous Rotation, UltraScan II
USCANII-2713	Triband Quad Polarization
USCANII-2713C	Triband Quad Polarization, Continuous Rotation

UltraScan OPTIONS

842746-2	Control cable and connectors (specify length in feet)
901586-1	High Gain Linear Amp, 30 dB, DC without bypass
901586-2	High Gain Linear Amp, 30 dB, DC with bypass



MRC UltraScan ANTENNA

With radome removed.

ADAPTIVE BROADBAND

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Adaptive Broadband products are manufactured under a quality system certified to ISO 9001. Adaptive Broadband reserves the right to make changes to specifications of products described in this data sheet at any time without notice and without obligation to notify any person of such changes.

GMS Parabolic

GMS high accuracy parabolic spun aluminum dishes are designed with rugged portability in mind. The selection of wide band, quick connect feeds are available from 1.7 Ghz with Linear or Circular polarization. Three sizes (14, 24, 30") and a variety of mounting configurations make these the professionals parabolic of choice for portable applications.

Let us help you configure your application, simply click on the "Sales Help" button at the top of this page.

14 Inch (35.5 cm) Diameter, Spun Aluminum, 2 lbs.

Band	Polarization	Size	Gain	Beamwidth
4.4 - 5.0 Ghz	Linear	14" round	21.7 dBi	14 deg.
5.7 - 5.9 Ghz	Linear / RHCP	14" round	23 dBi	12 deg.
6.4 - 7.4 Ghz	Linear / RHCP	14" round	25 dBi	9.5 deg.
12 - 16 Ghz	Linear	14" round	31 dBi	4 deg.

24 Inch (61 cm) Diameter, Spun Aluminum, 5 lbs.

Band	Polarization	Size	Gain	Beamwidth
1.7 - 2.7 Ghz	Linear / RHCP / LHCP	24" round	20 dBi	16 deg.
4 - 6 Ghz	Linear / RHCP / LHCP	24" round	27 dBi	7 deg.
6.4 - 7.2 Ghz	Linear / RHCP / LHCP	24" round	30 dBi	5 deg.
12 - 14.3 Ghz	Linear	24" round	36 dBi	2.6 deg.

30 Inch (76.2 cm) Diameter, Spun Aluminum, 7 lbs.

F I N A L A C T S

WRC-95

Final Acts of the World Radiocommunication Conference (WRC-95)

ITU

Geneva, 1995

ANNEX 2 TO RESOLUTION 46

A2.1 Coordination thresholds for sharing between MSS (space-to-Earth) and terrestrial services in the same frequency bands and between non-GSO MSS feeder links (space-to-Earth) and terrestrial services in the same frequency bands

A2.1.1 Below 1 GHz

In the bands 137 - 138 MHz and 400.15 - 401 MHz, coordination of a space station of the MSS (space-to-Earth) with respect to terrestrial services is required only if the power flux-density produced by the station exceeds -125 dB(W/m2/4 kHz) at the Earth's surface.

A2.1.2 Between 1 and 3 GHz

A2.1.2.1 Objectives

Generally, power flux-density thresholds were used to determine the need for coordination between space stations of the MSS (space-to-Earth) and terrestrial services. However, to facilitate sharing between digital fixed service (FS) stations and NGSO MSS space stations, the concept of fractional degradation in performance (FDP) was adopted. This concept involves new methods described in this Annex.

As a consequence of this new concept, the need for coordination between space stations of the MSS (space-to-Earth) and terrestrial services is determined using two methods:

- simple method: FDP (**simple** definition of the MSS system and characteristics of **reference** FS stations are used in inputs) or power flux-density trigger value;
- more detailed method: system specific methodology (SSM) (**specific** characteristics of the MSS system and characteristics of **reference** FS stations are used in inputs) as described, for example, in Annex 1 to Recommendation ITU-R IS.1143.

If one of the two methods gives a result that does not exceed the criteria relevant to each method, there is no need for coordination.

If only one method is available in an administration, the result of this method must be taken into account.

A2.1.2.2 General considerations

A2.1.2.2.1 Method for calculating the value of fractional degradation in performance (FDP)

The FDP is used in cases of sharing between digital FS stations with non-GSO MSS stations (space-to-Earth).

To calculate the value of the FDP, the following parameters are needed:

- technical characteristics of digital FS station;
- technical characteristics of non-GSO MSS constellation.

The FDP is calculated:

- by simulating the proposed MSS constellation using the information given in paragraph A.3 of Resolution **46**;
- by positioning the FS station at a certain latitude (each station is assumed to operate at an elevation angle of 0°);
- by calculating for each pointing azimuth (Az) varying between 0° and 360°:
  - at each instant in time of the simulation, the aggregate interference from all visible space stations received at the FS station;
  - the FDP_{Az} for the azimuth Az, using the following formula:

$$FDP_{Az} = \sum_{I_i = \min}^{\max} \frac{I_i f_i}{N_T}$$

- by the following formula:

$$FDP = \max(FDP_{Az})$$

  (The formula for FDP applies to the 1 - 3 GHz frequency range only. A different formula may apply at frequencies above 3 GHz.)

where:

I_i = interference noise power level (W)

f_i = the fractional period of time during which the interference power equals I_i

N_T = station receiving system noise power level = kTB (W)

k = Boltzmann's constant = $1.38 \cdot 10^{-23}$ (J/K)

T = FS station receiving system effective noise temperature (T should be calculated by the following formula: $10 \log T = NF + 10 \log T_0$ where NF (dB) is the receiver noise figure given in Annex 1 and T_0 should be assumed as 290 K)

B = reference bandwidth = 1 MHz

NOTE – For the purpose of FDP calculation according to this Annex, it should be assumed that all space stations in the same MSS constellation operate on the same frequencies.

A2.1.2.2.2 Characteristics of reference systems in the fixed service

The following parameters represent the set of reference parameters of the fixed service.

A2.1.2.2.2.1 Characteristics of reference digital point-to-point systems

Three different digital systems are described in this table:

- 64 kbit/s capacity used, for example, for outside-plant (individual subscriber connection);
- 2 Mbit/s capacity used, for example, for business subscriber connections for the local part of the inside-plant;
- 45 Mbit/s capacity used, for example, for trunk networks.

Capacity	64 kbit/s	2 Mbit/s	45 Mbit/s
Modulation	4-PSK	8-PSK	64-QAM
Antenna gain (dB)	33	33	33
Transmit power (dBW)	7	7	1
Feeder/multiplexer loss (dB)	2	2	2
e.i.r.p. (dBW)	38	38	32
Receiver IF bandwidth (MHz)	0.032	0.7	10
Receiver noise figure (dB)	4	4.5	4
Receiver input level for a BER of 10^{-3} (dBW)	-137	-120	-106
Maximum long-term interference Total power (dBW)	-165	-151	-136
Maximum long-term interference Power spectral density (dB(W/4 kHz))	-174	-173	-170

Antenna pattern:

$G(\varphi) = G_{max} - 2.5 \times 10^{-3} \left(\frac{D\varphi}{\lambda}\right)^2$ for $0 < \varphi < \varphi_m$

$G(\varphi) = G_1$ for $\varphi_m \leq \varphi < 75.86(\lambda/D)$

$G(\varphi) = 49 - 10 \log (D/\lambda) - 25 \log \varphi$ for $75.86(\lambda/D) \leq \varphi < 48°$

$G(\varphi) = 7 - 10 \log (D/\lambda)$ for $48° \leq \varphi$

where:

$G(\varphi)$: gain relative to an isotropic antenna (dBi)

φ: off-axis angle (degree)

D: antenna diameter

λ: wavelength expressed in the same unit as D

G_1: gain of the first side-lobe = $2 + 15 \log (D/\lambda)$

(D/λ may be estimated from $20 \log D/\lambda \approx G_{max} - 7.7$)

G_{max}: main lobe antenna gain (dBi)

$\varphi_m = 20 (\lambda/D) \times \sqrt{(G_{max} - G_1)}$ (degrees)

It should be noted that the above antenna radiation pattern corresponds to the average side-lobe pattern and it is recognized that individual side-lobes may exceed it by up to 3 dB.

A2.1.2.2.2.2 Characteristics of reference analogue point-to-point systems

Antenna gain (dBi)	33
e.i.r.p. (dBW)	36
Feeder/multiplexer loss (dB)	3
Receiver noise figure (referred to input of receiver) (dB)	8
Maximum long-term interference per link (20% of time) (dB(W/4 kHz))	-170

Antenna pattern: Use antenna pattern of section 2.2.1.

A2.1.2.2.2.3 Characteristics of reference point-to-multipoint systems

Parameter	**Central station**	**Outstation**
Antenna type	**Omni/Sectoral**	**Dish/Horn**
Antenna gain (dBi)	10/13	20 (analogue) 27 (digital)
e.i.r.p. (max) (dBW) analogue digital	 12 24	 21 34
Noise figure (dB)	3.5	3.5
Feeder loss (dB)	2	2
IF bandwidth (MHz)	3.5	3.5
Maximum permissible long-term interference power (20% time) Total (dBW) dB (W/4 kHz) dB (W/MHz)	 -142 -170 -147	 -142 -170 -147

Antenna pattern:

For the outstation antenna pattern, the reference pattern described in section 2.2.1 has to be used.

The reference radiation pattern for omnidirectional or sectoral antennas is the following:

$$G(\theta) = G_0 - 12\,(\theta/\varphi_3)^2,\ \text{dBi} \qquad 0 \le \theta < \varphi_3$$

$$G(\theta) = G_0 - 12 - 10\log(\theta/\varphi_3),\ \text{dBi} \qquad \varphi_3 \le \theta \le 90°$$

where:

G_0 = maximum gain in the horizontal plane (dBi)

θ is the radiation angle above the horizontal plane (degrees)

φ_3 (degrees) is given by:

$$\varphi_3 = \frac{1}{\alpha^2 - 0.818}, \text{degrees}$$

where:

$$\alpha = \frac{10^{0.1G_0} + 172.4}{191}$$

It should be noted that the above antenna pattern is provisional and that further study is under way in the ITU-R.

A2.1.2.3 Determination of the need for coordination between MSS space stations (space-to-Earth) and terrestrial stations

A2.1.2.3.1 Method for the determination of the need for coordination between MSS space stations (space-to-Earth) and other terrestrial services sharing the same frequency band in the 1 to 3 GHz range

Coordination of space stations of the mobile-satellite service downlink with respect to terrestrial services is not required if the power flux-density produced at the Earth's surface or the fractional degradation in performance (FDP) of a station in the fixed service does not exceed the threshold values shown in the table.

Frequency band (MHz)	Service to be protected	Coordination threshold values				
		Geostationary space stations		Non-geostationary space stations		
		pfd (per space station) calculation factors (NOTE 2)		pfd (per space station) calculation factors (NOTE 2)		% FDP (in 1 MHz) (NOTE 1)
		P dB(W/m^2) in 4 kHz	r dB/deg	P dB(W/m^2) in 4 kHz	r dB/deg	
1 492 - 1 525	analogue FS	-152	0.5	-152	0.5	
	digital FS	-152	0.5			25
	other terrestrial services (NOTE 4)	-152	0.5	-152	0.5	
1 525 - 1 530	analogue FS	-152	0.5	-152	0.5	
	digital FS	-152	0.5			25
	other terrestrial services (NOTE 4)	-152	0.5	-152	0.5	
2 160 - 2 200 (NOTE 3)	analogue FS	-152	0.5	-147	0.5	
	digital FS	-152	0.5			25
	other terrestrial services (NOTE 4)	-152	0.5	-147	0.5	
2 483.5 - 2 500	fixed	-152	0.5	-150	0.65	
	other terrestrial services (NOTE 4)	-152	0.5	-150	0.65	
2 500 - 2 520	analogue FS	-152	0.5	-152	0.5	
	digital FS	-152	0.5			25
	other terrestrial services (NOTE 4)	-152	0.5	-152	0.5	
2 520 - 2 535	analogue FS	-160	0.75	-152	0.5	
	digital FS	-160	0.75			25
	other terrestrial services (NOTE 4)	-160	0.75	-152	0.5	

NOTE 1 – The calculation of FDP (fractional degradation in performance) is contained in section 2.1, using reference FS parameters contained in sections 2.2.1 and 2.2.3.

NOTE 2 – The following formula should be used for deriving the coordination threshold in terms of power flux-density:

P dB($W/m^2/4$ kHz)	for $0° \leq \delta \leq 5°$
P + r(δ-5) dB($W/m^2/4$ kHz)	for $5° < \delta < 25°$
P + 20r dB($W/m^2/4$ kHz)	for $25° \leq \delta \leq 90°$

where δ is the angle of arrival (degrees).

The threshold values are obtained under assumed free-space propagation conditions.

NOTE 3 – The coordination threshold in the band 2 160 - 2 270 MHz (Region 2) and 2 170 - 2 200 MHz (all regions) to protect other terrestrial services does not apply to the terrestrial component of the Future Public Land Mobile Telecommunication Systems (FPLMTS), as the satellite and the terrestrial components are not intended to operate in the same area or on common frequencies within these bands.

NOTE 4 – The coordination threshold factors applicable to other terrestrial services may be reviewed at a future conference, as necessary.

A2.1.2.3.2 A system-specific methodology (SSM) to be used in determining the need for detailed coordination of NGSO MSS (space-to-Earth) systems with fixed service systems

The purpose of the system-specific methodology (SSM) is to allow a detailed assessment of the need to coordinate frequency assignments to non-GSO MSS space stations (space-to-Earth) with frequency assignments to receiving stations in an FS network of a potentially affected administration. The SSM takes into account specific characteristics of the non-GSO MSS system and reference FS characteristics.

Those administrations planning to establish the need for coordination between non-geostationary-satellite networks in the mobile-satellite service and fixed service systems are encouraged to use Recommendation ITU-R IS.1143. While urgent additional development work is being undertaken in the ITU-R to facilitate the use of the methodology described in Recommendation ITU-R IS.1143, administrations may be able to effect coordination by applying this system-specific methodology.

A2.1.3 Above 3 GHz

In the band 15.45 - 15.65 GHz, when an administration proposes to use a non-geostationary space station whose emissions exceed -146 dB(W/m^2/MHz) for all angles of arrival, it shall coordinate with affected administrations.

A2.2 Hard limits

A2.2.1 Sharing between feeder links of the non-GSO MSS (space-to-Earth) and terrestrial services in the same frequency bands

The power flux-density at the Earth's surface produced by space stations of the fixed-satellite service operating in the space-to-Earth direction in the band 5 150 - 5 216 MHz shall in no case exceed -164 dB(W/m^2) in any 4 kHz band for all angles of arrival.

Emissions from a non-geostationary space station shall not exceed the following limits at the Earth's surface:

Frequency band	Service	Limit in dB(W/m^2) for angle of arrival above the horizontal plane			Reference bandwidth
		0° - 5°	5° - 25°	25° - 90°	
6 700 - 6 825 MHz	Fixed-Satellite (S-E)	-137	-137 + 0.5 (δ-5)	-127	1 MHz
6 825 - 7 075 MHz	Fixed-Satellite (S-E)	-154 and	-154 + 0.5 (δ-5) and	-144 and	4 kHz
		-134	-134 + 0.5 (δ-5)	-124	1 MHz

Emissions from a non-geostationary space station shall not exceed the power flux-density limits at the Earth's surface of -146 dB(W/m^2/MHz) in the bands 15.4 - 15.45 GHz and 15.65 - 15.7 GHz, and -111 dB(W/m^2/MHz) in the band 15.45 - 15.65 GHz for all angles of arrival. These limits relate to the power flux-density which would be obtained under assumed free-space propagation conditions.

Power flux-density limits between 17.7 GHz and 27.5 GHz.

The power flux-density at the Earth's surface produced by emissions from a space station, including emissions from a reflecting satellite, for all conditions and for all methods of modulation, shall not exceed the following values:

-115 dB(W/m^2) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

-115 + 0.5(δ-5) dB(W/m^2) in any 1 MHz band for angles of arrival δ between 5 and 25 degrees above the horizontal plane;

-105 dB(W/m^2) in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

These limits relate to the power flux-density which would be obtained under assumed free-space propagation conditions.

In the band 19.3 - 19.7 GHz for non-geostationary satellite systems, these values shall apply subject to review by the ITU-R and the results of this review should be considered by WRC-97 (see Resolution COM5-1).

INTERNATIONAL TELECOMMUNICATION UNION
RADIOCOMMUNICATION SECTOR

Conference Preparatory Meeting

CPM Report on technical, operational and regulatory/procedural matters to be considered by the 1995 World Radiocommunication Conference

GENEVA, 1995

In the first case it was demonstrated that the LEO H feeder-link system in Table 7 would be able to share the 5 and 7 GHz bands bidirectionally with the LEO D and LEO F1 feeder-link systems. (Note that LEO F parameters in Table 7 were designed for the 5 and 7 GHz bands and initially termed LEO "F1" parameters, while the LEO "F3" parameters were designed for the 20 and 30 GHz bands.)

In the second case it was demonstrated that bidirectional sharing of the same frequency sub-band in the 20 GHz range (see Table 15) would be possible. In this case the technical characteristics of LEO A and LEO B down-links and LEO F3 up-links were used in the analysis. The steerable spot beam antennas on-board the spacecraft would result in very infrequent and short-term satellite-to-satellite interference. The interference levels were shown not to exceed an I/N criterion of -1 dB. Even if the satellites were to operate at Article 28 maximum pfd levels, the short-term interference would meet an I/N criterion of -1 dB for all cases, except for the transmitting higher altitude ICO satellites, which could require a pfd limit reduction of less than 5 dB.

Noting that bidirectional co-frequency sharing between non-GSO /MSS feeder-link systems would require some of them to operate co-directionally with any GSO/FSS networks existing in the same band, the need to protect the GSO networks would have to be taken into account in any consideration of such bidirectional sharing.

3.4.3 Sharing between non-GSO/MSS feeder links and non-GSO/FSS networks

Frequency sharing between non-GSO/MSS feeder-link networks and non-GSO/FSS networks requires further study. An example of a system for which further study is needed is one proposed non-GSO network that would provide communications in both the FSS and MSS at 20/30 GHz. Sharing studies that model the frequency and periods of in-line interference between non-GSO/MSS feeder links and this type of non-GSO network should be conducted.

3.5 Regulatory/procedural provisions for non-GSO mobile-satellite feeder link network

See Section 2.4.1 in Chapter 4.

3.6 Frequency sharing between non-GSO/MSS feeder links and networks in the fixed service

3.6.1 Characteristics of typical FS carriers

Recommends 2 of Recommendation ITU-R F.758 states that the information provided in its Annex 2 should be used as guidance to the technical characteristics and sensitive sharing parameters of fixed service systems that need to be taken into account when developing criteria for sharing with other services. This Annex provides information on FS systems above 10 GHz, but does not cover the range 3 - 10 GHz. The information in Tables 12 and 13 was provided on FS characteristics for frequency sharing in the 3 - 10 GHz band.

TABLE 12

Fixed service parameters for sharing between 3 and 10 GHz

Frequency band (GHz)	3.4 - 5.0			4		5.850 - 7.075			7.075 - 8.500	
Modulation	FM/ FDM	16-QAM	512-QAM	QPSK, CDMA 2 MB/s fixed point-multipoint L/A radio Central station	Out station	FM/ FDM	16-QAM	512-QAM	FM	64-QAM
Channel spacing (MHz)	29	20	40	2	2	29.65	20	30	20	30
Antenna gain (dB)	41	42.5	40	16	16	45	45	43	45	44
Feeder/Mux loss (dB)	3	4	3	8	18	4	4	3	5	3
Antenna type	dish	horn	horn/ dish	-	-	dish	horn	dish	dish	dish
Max Tx output (dBW)	+13	-7.1	+7(2)	2	2	+13	-9.8	+4	+10	+3
e.i.r.p. max. (dBW)	51	28.4	44	10	0	55	28.2	44	50	44
Rx therm noise (dBW/ch)	-119	-128.1	-126	-117	-117	-121	-128.1	-125	-122	-125
Rx I/P for 10^{-3} BER(dBW)	-	-	-93	-	-	-	-	-102	-	-100
Rx I/P for 10^{-6} BER(dBW)	-	-	-	-118	-118	-	-	-	-	-
Nom long-term Interferer (I/N = 13 dB(1) (dBW)	-129	-	-139	-	-	-131	-	-138	-132	-138
Eqv. power dB(W/4 kHz)	-170	-	-	-164	-164	-171	-	-	-170	-
Spect. dens. dB(W/MHz)	-	-	-155	-140(3)	-140(3)	-	-	-153	-	-153
Typical fade margin (dB)	-	-	-	30	30	-	-	-	-	-
Path length (km)	-	-	-	3	3	-	-	-	-	-

(1) Objective for FS systems employing space diversity.

(2) -7 dBW transmit power and +30 dBW e.i.r.p. without APC.

(3) Measured at antenna port.

TABLE 13

Trans-horizon systems in the band 4 500 - 4 800 MHz

Transmitter				Receiver	
Equipment type	**Power (kW)**	**Antenna gain (dBi)**	**Emission bandwidth (MHz)**	**Noise figure (dB)**	**Antenna gain (dBi)**
H	1.0	38	7	5.0	38
I	10	47	7	4.0	47
J	10	49	5	9.0	49
K	1.0	40	2	4.0	40
L	6.6	45	3.5	3.0	45

3.6.2 Current use of FS allocations

The FS is allocated to many frequency bands which are also allocated to the FSS in the range 3 - 31 GHz. § 2.1 provides an evaluation of the current situation in these bands. Sharing difficulties between non-GSO/MSS feeder link earth stations and FS stations seem to be of the same magnitude as between FSS and FS.

The feasibility of sharing would, however, depend on the density of existing fixed systems and the number of non-GSO/MSS feeder link earth stations. One contribution has indicated that "the number of gateways per system is small". § 1 gives information on the proposed non-GSO/MSS systems. These range from 25 to 200 worldwide.

Even though Recommendation ITU-R SF.1005 had addressed bands above 10 GHz only, for bidirectional usage by GSO/FSS, it may be possible to identify bands which are lightly occupied by FS, to accommodate non-GSO/MSS feeder links.

3.6.3 Related procedures and Recommendations

The Radio Regulations which apply to sharing between the FS and FSS may be found in Articles 27 and 28. They apply to limits on e.i.r.p. levels and pfd limits. Appendix 28 allows for the determination of coordination distance between GSO earth stations and FS stations.

The ITU-R Recommendations which have applicability to non-GSO/MSS feeder-link sharing with FS are indicated below. They will need to be reviewed at WRC-95 for appropriate incorporation into the Radio Regulations.

pfd levels

– Recommendation ITU-R SF.358 indicates the maximum permissible values of pfd produced at the surface of the Earth by FSS satellites. Further studies are needed to evaluate the adequacy of these limits for a whole constellation of non-GSO/MSS satellites.

- Recommendation ITU-R SF.1005 states that, for RBW satellites, the pfd values given in Recommendation ITU-R SF.358-4 should be lowered by 3 to 7 dB for angles of arrival within 5° above the horizontal under free-space propagation conditions in case of bidirectional usage in bands above 10 GHz for GSO systems. Although GSO or non-GSO satellites are not mentioned, it is likely the application of this Recommendation may be different in both cases.

e.i.r.p. limits

- Recommendation ITU-R SF.1004 gives e.i.r.p. limits to be applied for earth stations transmitting within 5° above the horizontal. No Recommendation exists to raise or lower this value for non-GSO/MSS employing RBW. However, even though Recommendation SF.1005 was developed for application to FSS GSO systems, its *recommends* 5 may be applicable to non-GSO/MSS feeder links.
- Recommendation ITU-R SF.406 gives e.i.r.p. limits on radio-relay system transmitters operating in the bands shared with the FSS (Earth-to-space). It may be necessary to apply some provisions of this Recommendation to the frequency bands which may be additionally allocated to the FSS (Earth-to-space) for use by non-GSO MSS feeder links.

Coordination area

- Recommendation ITU-R IS.847 provides for determination of coordination area of an earth station operating with a GSO space station shared with a terrestrial station.
- Recommendation ITU-R IS.849 can be used to determine coordination area of earth stations operating with non-GSO spacecraft.
- Recommendation ITU-R SF.1005 states that for RBW satellite networks, the interference criteria to be used in the determination of coordination area in accordance with Recommendation IS.847 should be tightened by 3 - 7 dB in frequency bands above 10 GHz in case of interference from FSS earth stations to radio-relay systems.

These Recommendations can be used to draw coordination contours around MSS feeder link earth stations either in forward or reverse band working.

3.6.4 Interference from MSS feeder link satellite to FS station

3.6.4.1 Highest level of interference

The highest level of interference occurs when a non-GSO/MSS satellite is within the main beam of a terrestrial system antenna. For a given non-GSO constellation, percentage of interference, duration of interference and mean time between interference events will be very dependant on FS latitude and FS link azimuth.

3.6.4.2 Statistics of worst-case interference

The worst-case interference is from azimuth directions where the probability of exceeding a certain interference level is at its maximum. Depending on orbital parameters (altitude, inclination) and FS station latitude and elevation, there are one to four worst-case azimuths. However most of those terminals will not point to the worst-case azimuths and in some cases there are azimuth directions where the satellite would not appear within the main beam of an FS station.

From geometrical considerations of a hypothetical 12 hop FS radio-relay network and of an ICO MSS constellation the following would characterize the worst-case interference scenario:

1) the maximum number of satellites simultaneously visible to any FS stations would not be greater than five;

2) no individual terrestrial terminal would receive interference via its mainbeam from more than one satellite at a time and it is improbable that a 1 000 km multiple hop link will receive mainbeam interference from more than one satellite at a time;

3) whenever a satellite interfered via the mainbeam of a particular microwave terminal, the same satellite would interfere via the side lobes of the other terminals;

4) the likelihood of simultaneous mainbeam interference entries to two terminals of the same radio-relay link may be considered, in the worst case, in the hypothetical 12 hop system;

5) in the worst case only every other hop could operate on the same frequency in the same transmission direction.

3.6.4.3 Criteria

Recommendation ITU-R F.1094 recommends a performance degradation criterion of 10% for services shared on a co-primary basis. Recommendation ITU-R SF.357 specifies interference criteria into an analogue radio-relay route. Recommendation ITU-R SF.1005 recommends that for shared bands allocated in both directions to the FSS (GSO only), the pertinent interference criterion be more stringent by 7 dB, 5 dB and 3 dB in the bands 10 - 15.4 GHz, 15.4 - 20 GHz and above 20 GHz, respectively.

Recommendation ITU-R SF.1005 is limited to frequency bands above 10 GHz because most bands below 10 GHz are heavily used by the FS. Even though Recommendation ITU-R SF.1005 had addressed bands above 10 GHz only, for bidirectional usage by GSO/FSS, it may be possible to identify bands below 10 GHz which are lightly occupied by FS to accommodate non-GSO/MSS feeder links. While Recommendation SF.1005 deals only with GSO/FSS, it is recognized that similar concepts would be applicable to bands below 10 GHz where there could be significant bidirectional usage by the FSS. However, for such bands below 10 GHz where there is no significant usage by GSO/FSS, no additional constraints on reverse band working non-GSO/MSS feeder link will be necessary

Taking account of the above, in the bidirectionally allocated bands that have significant usage in both directions, it is recognized that some tightening of the FDP criterion of 10% would be required when considering interference from RBW non-GSO/MSS feeder links. This would not apply to bidirectionally allocated FSS bands that do not have significant GSO/FSS usage. This value of 10% FDP would also apply for RBW non-GSO/MSS feeder links in the band where there is no significant GSO/FSS usage or in the forward band working case where there is no GSO/FSS usage.

3.6.4.4 Some results of simulation for LEO-A

The performance degradation that an FS station located at 56.5° would experience assuming the LEO earth station is at 60° latitude for various pointing azimuths shows that for all azimuths, the performance degradation criterion is met and remains below 3%. It has been shown that for the following conservative or worst case assumptions, the 10% criterion was still met:

– the LEO satellite e.i.r.p. was increased to its rain fade compensated value;

– no atmospheric attenuation was taken into account;

- the FS station was assumed to have a 5° elevation angle above the horizontal;
- the FS station was sited such that the performance degradation was maximized;
- calculations were performed in a 1 MHz reference bandwidth;
- the non-GSO satellite's minimum elevation angle was kept at 8° although it would normally be somewhat higher for those latitudes assumed in this study.

3.6.4.5 Some results of simulation for LEO-D

Performance degradation experienced by a FS station located at 40° latitude due to interference from a LEO-D constellation operating at 6 GHz band is very low. LEO-D proposes to use an isoflux antenna which tends to create the same pfd on the surface of the Earth regardless of arrival angle. The simulation assumed an Appendix 30B roll off which will give better results than the isoflux antenna. However, with the FDP being three to four orders of magnitude less than the most stringent interference criterion, one can still conclude that LEO-D can share quite easily.

3.6.4.6 Some results of simulation for LEO-F

Simulation exercises for the LEO-F constellation have produced a maximum value of FDP of 0.6% in the 6 GHz band for FS systems that employ dual diversity. This value corresponds to an FS station latitude of 20°N and 48.5° azimuth. For 20 GHz and 11 - 13 GHz bands configuration of LEO-F, similar exercises have resulted in maximum FDP values of less than 0.1%. Given that all the results show that even for a stringent FDP criterion of 1% all FS azimuths produce FDP values less than this, it is concluded that all four LEO-F configurations can share with digital systems in their respective frequency band.

3.6.4.7 Relevance of Recommendation ITU-R SF.358

The power-flux-density limits of Recommendation ITU-R SF.358 can result in interference from GSO satellites greater than thermal noise in radio-relay system receivers. However the application of such measures as pointing the radio-relay beam several degrees away from the GSO orbit ameliorates the interference thus facilitating FS/FSS GSO sharing. In the case of non-GSO/MSS feeder links sharing with the FS will take place successfully with the application of a pfd limit, which generates interference that far exceeds the thermal noise for radio-relay systems for short periods of time because the affected receiver will not usually experience fading at the same time that it is receiving this high level of interference. As a result, even though this boresight interference event cannot be avoided, the FDP criterion of 10% can still be satisfied. Therefore Recommendation ITU-R F.1108 may be a more appropriate approach.

3.6.4.8 Proposed Article 28 pfd limits

For discussion regarding difficulty in using the congested FSS bands in RBW, refer to § 3.2.4. For the analysis of current FSS allocations, refer to Table 15. Based on analyses using non-GSO/MSS feeder link characteristics in Table 7 and discussion of mitigating factors, the following pfd limits are proposed to be applicable to each non-GSO/MSS satellite operating in a reverse band mode, in a band heavily used by GSO/FSS:

6 - 8 GHz:	-158/-148 dB(W/m2/4 kHz) or -134/-124 dB(W/m2/MHz)[1]
13 - 15 GHz:	-150/-140 dB(W/m2/4 kHz) or -126/-116 dB(W/m2/MHz)[1]

For those bands which are used by non-GSO/MSS feeder-links and are not shared bidirectionally with GSO/FSS, or are lightly used by the GSO/FSS in the other direction, the following pfd limits are proposed:

6 - 8 GHz:	-154/-144 dB(W/m2/4 kHz) or -130/-120 dB(W/m2/MHz)[1]
13 - 15 GHz:	-148/-138 dB(W/m2/4 kHz) or -124/-114 dB(W/m2/MHz)[1]
17.7 - 19.7 GHz:	-115/-105 dB(W/m2/MHz)

The lower values are for arrival angles up to 5° and the higher values for arrival angles between 25° and 90°. For arrival angles between 5° and 25°, the pfd limits should be linearly interpolated.

In order to select the appropriate pfd limit, consideration should also be given to the use of the band by the FS.

3.6.5 Interference from radio-relay stations to the MSS feeder link satellite

Explanation of the worst-case interference may be found in §§ 3.6.4.1 and 3.6.4.2.

3.6.5.1 Criteria for acceptable interference (FBW and RBW)

The acceptable interference criteria for non-GSO/MSS satellites for FBW and RBW in FSS allocations would generally be the same. Non-GSO/MSS is still in the planning stages and no ITU-R Recommendations on either the performance objectives or maximum permissible interference in a digital channel in a non-GSO/MSS network are yet available.

However, in order to progress the work of establishing the sharing feasibility of non-GSO/MSS feeder links, based on an analysis relating to the case of transparent transponders with 4 - 8 GHz band feeder links, ITU-R has decided upon the following short-term protection criteria for 4 - 8 GHz band non-GSO/MSS feeder links. The criteria for single entry interference from GSO/FSS networks to non-GSO/MSS feeder links described in § 3.1.2 may be used to assess the sharing feasibility of 4 - 8 GHz band non-GSO/MSS feeder links with FS in co-directional working mode.

Studies were based upon three protection criteria ranging from 2.5%, 6% to 12.5% of total noise. For the example ICO system the end-to-end performance for both forward and return connections is designed to provide an overall $C/N_0 \geq 48.0$ dB(Hz) under rain-fade conditions. In the feeder-link carrier bandwidth this corresponds to C/N = 48.0 - 10 log (30 000) = 3.2 dB. So the protection ratios used in the studies were 19.2, 15.4 and 12.2 dB.

3.6.5.2 Methodology of analytical calculations

The maximum number of co-frequency transmitting terminals can be equal to the number of hops in the link, and this would correspond to an absolute worst-case. For the hypothetical link considered here there are 12 transmitters on frequency f_1 in a north-south distance of 337.5 km in the 6 GHz band case, and 258.5 km in the 14 GHz band case. Each of the 12 transmitters has a different azimuth bearing (although some pairs are parallel) and it was assumed that each has 0° elevation. In practice

[1] The 1 MHz reference bandwidth is generally applicable for the protection of both analogue and digital radio-relay systems, however the 4 kHz reference bandwidth was added for consistency with current Article 28 pfd limits.

Globalstar USA, Inc.
Globalstar, L.P.
ET Docket No. 98-142
Mobile Satellite Service Above 1 GHz.

1. Sharing Between NGSO MSS and Terrestrial Stations at 6/7 GHz

The broadcast and FS communities have raised concerns with regard to the allocation for feeder downlinks at 6700-7075 MHz.

- It is claimed that the band is heavily used now for BAS and/or FS. According to the FS and BAS comments, the MSS community has not demonstrated that FS and BAS stations will be adequately protected.
- A fear was expressed that the recommended PFD limits for NGSO MSS feeder links are sufficient to protect analog stations but may not be sufficient to protect digital stations.

2. Protection Requirements Generally for FS and BAS

In proposing the allocation for NGSO MSS feeder links at 6/7 GHz, the Commission is also proposing to adopt the ITU's recommended PFD limits.

- The ITU took into account the need to protect FS and BAS users in the band. WRC-95 adopted PFD limits for space-to-earth feederlinks in these bands specifically to protect terrestrial stations.
- The PFD limits for feederlink space-to-earth transmissions adopted at WRC-95 for the 6700-6825 MHz are:

Reference Bandwidth	0-5 degrees	5-25 degrees	25-90 degrees
1 MHz	-137	$-137+0.5(\delta-5)$	-127

Limit in dB(W/m2) for Angle of Arrival δ
Above the Horizontal Plane

- The PFD limits for feederlink space-to-earth transmissions adopted at WRC-95 for the 6825-7075 MHz are:

Reference Bandwidth	0-5 degrees	5-25 degrees	25-90 degrees
4 kHz	-154	$-154 + 0.5(\delta - 5)$	-144
1 MHz	-134	$-134 + 0.5(\delta - 5)$	-124

Limit in dB(W/m2) for Angle of Arrival δ
Above the Horizontal Plane

- In its proceeding to prepare for WRC-95, the Commission recognized that the CPM was studying the sharing environment for terrestrial stations and NGSO MSS feederlinks in the 6/7 GHz band, and that those studies would form the basis for any need to address specific concerns from the FS and broadcasters.

- The Commission has indicated that the need for further study would not bar the allocation for NGSO MSS feederlinks: "this should not be a hindrance to making spectrum available internationally for feeder links at WRC-95." Report, 10 FCC Rcd 12783, ¶ 54 (1995).

3. Protection for Digital Operations

Contrary to the claims of the FS and BAS commenters, digital operations of FS and BAS stations in these bands has been a component of every study in the United States and ITU.

- WRC-95 CPM developed analyses of "Fractional Degradation in Performance" ("FDP") to study the impact of satellite transmissions on terrestrial digital operations. See WRC-95 Final Acts, Res. 46, Annex 2, A2.1.2.1 ("to facilitate sharing between digital fixed service (FS) stations and NGSO MSS space stations, the concept of fractional degradation in performance was adopted"); CPM Report, § 3.6.4.3.

- Each recommended PFD standard includes a PFD level with a reference bandwidth of 4 kHz for protection of analog stations, and a PFD level with a reference bandwidth of 1 MHz for protection of digital stations, which would be more stringent than the equivalent of the analog limit extended to 1 MHz.

- Indeed, the recommendation of the CPM for protection of digital stations (-130 dB(W/m2/1 MHz))was made more stringent by WRC-95. The CPM found that an NGSO MSS satellite system with parameters like Globalstar "can share quite easily" with digital FS systems at 6 GHz. CPM Report, § 3.6.4.5.

4. Coordination Between NGSO MSS Earth Stations and FS/BAS Stations

The broadcasters and FS recommended that the FCC adopt "sensible sharing and coordination procedures." NAB Reply Comments, at 3. Such procedures should include detailed technical information on operation of the earth station. TIA Comments, at 6. Earth station operators should be required to coordinate with broadcasters so that the latter know where earth stations are located and what protection criteria need to be employed for new BAS links. SBE Comments, at 3. The proposals outlined by Globalstar USA, Inc., and Globalstar, L.P., satisfy these requests.